



Agrifood importing firms amid a global health crisis

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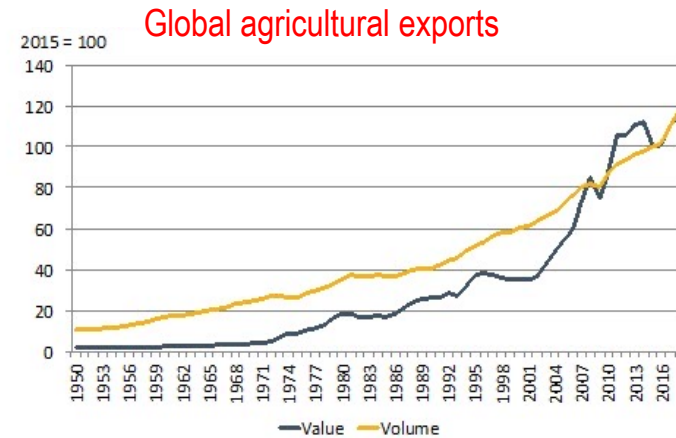
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Increasing agricultural trade and biosecurity risks

- Trade-related mobility can be a vector for disease transmission
- This century has already seen many multi-country epidemics, e.g., SARS, MERS, Ebola, avian flu, African swine fever
 - These shocks were more localized
- For a global health crisis, how did firms react?
- Changes in firm performance may result from idiosyncratic shocks (Cheptea & Gaigné, 2020; Shepotylo et al., 2022) or from idiosyncratic reactions to common shocks



Source: WTO, World Trade Statistical Review 2019



Fast paced nature of the pandemic requires new data

- During the crisis, economic activity fell dramatically within a few days but also rebounded quickly after the first wave of lockdowns
- Requires different data to access effects in real time
- We provide first set of evidence using daily customs transaction firm-level import data
- Compliments existing monthly firm-level evidence from Colombia (Benguria, 2021), Portugal (Pimenta et al., 2021), Kenya (Majune & Türkcan, 2022) and France (Bricongne et al., 2022; Lafrogne-Joussier et al., 2022; Brussevich et al., 2022)



Macro-evidence ignores underlying heterogeneities

- In the agricultural economic literature, existing evidence are at the macro-level (Arita et al. 2022; Engemann and Jafari, 2022; Ahn and Steinbach, 2022)
- The magnitude and channels of the agricultural trade effects of the pandemic at the firm level are not yet clear
- While countries as an aggregate may have been affected relatively less than expected by the pandemic, this is not necessarily the case for firms
- We contribute the first firm-level response to the pandemic in the agricultural sector



The role of firm size in reacting to common shocks

- Understand the role of large firms and why they react more to common shocks
- Large French firms are more sensitive to foreign shocks because they trade more (Di Giovanni et al. 2020) and/or exhibit a higher elasticity to foreign demand shocks (Bricongne et al. 2022)
- We offer an explanation linked to firm-level employment



What do we find?

- The pandemic led to a reduction of firm-level imports at the product level:
 - Elasticity of daily imports to the COVID shock is 30%, driven mostly by a decrease in the number of importing firms (mostly incumbents), larger firms and products closest to the final consumer were affected more, the level of data aggregation matters
- We test different mechanisms that may drive our findings:
 - Pandemic-related closures in origin countries drove the drop in Swiss firm level imports and increased import prices, Consumer mobility restrictions in Switzerland decreased consumer demand



Data: daily firm-level import data

- Universe of Swiss agrifood importing firms
- Daily HS8 digit imports in 2019 and 2020

Table 1

Swiss agri-food firms and their importing characteristics.

	Origins	Products	Firms	Import value		Origins/firm
				Mean	Median	
<i>Panel a: distribution across years</i>						
Year						
2019	190	2075	26857	5029	386	2
2020	189	2068	28893	5051	365	2
2019 & 2020	196	2292	39535	5041	375	2
<i>Panel b: distribution based on firm structure</i>						
Firm size						
<10 employees	187	2059	30319	2063	156	2
10–49 employees	177	1827	6196	4962	520	3
50–249 employees	169	1754	2827	7091	813	4
>249 employees	161	1690	1195	10000	1385	6

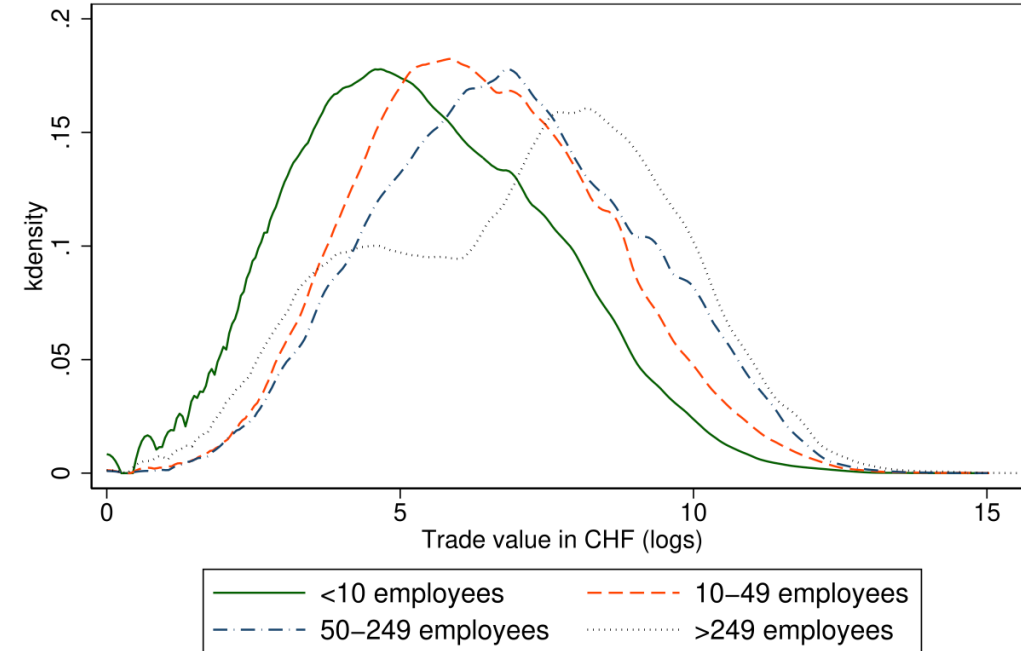
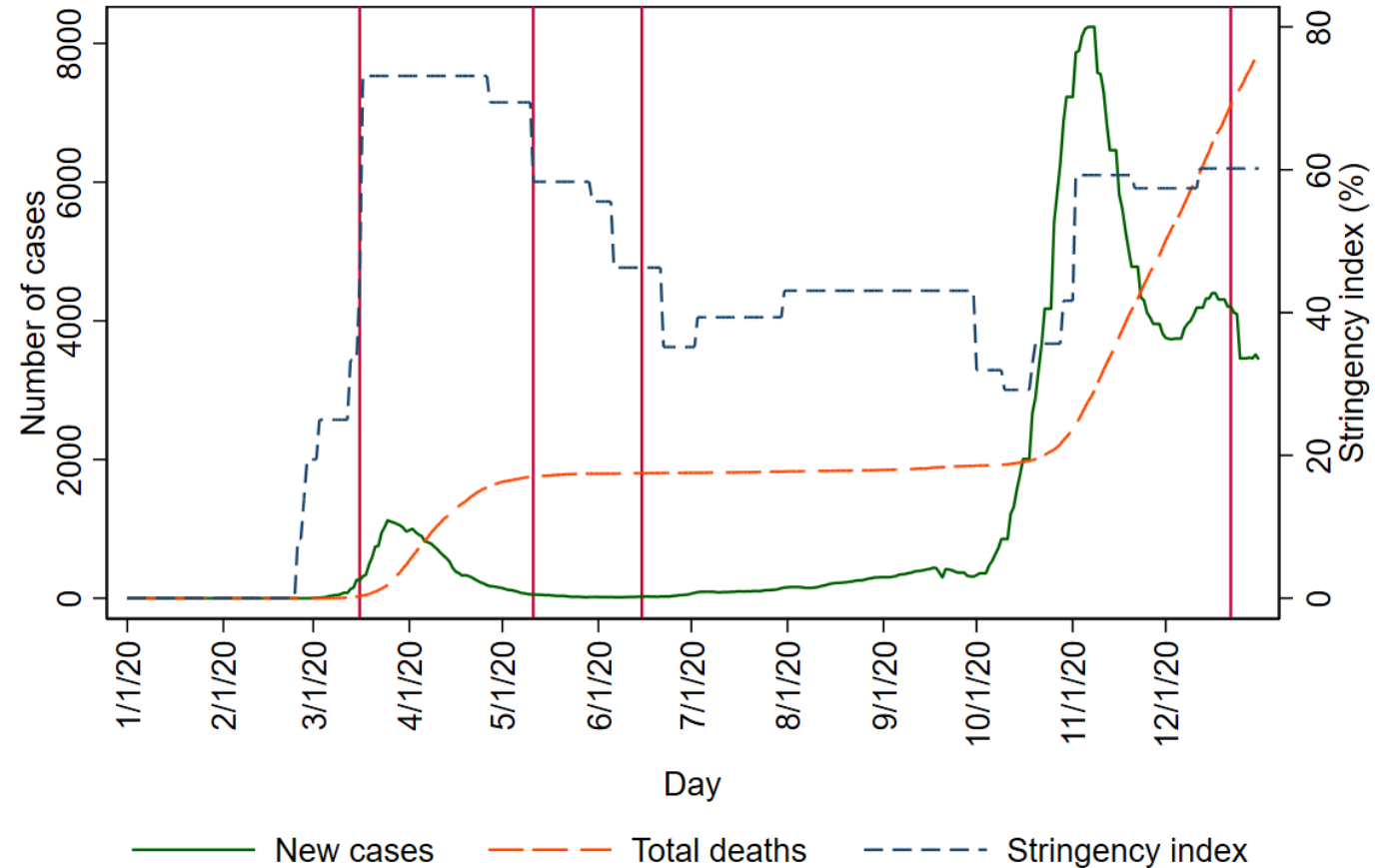


Fig. 1. Imports by firm size.



Data: Covid incident rates in Switzerland

Figure 2: Swiss daily Covid-19 incident rates in 2020





Decomposing Swiss imports into different trade margins

We express Swiss imports of HS6 digit product p on day t summed across firms, HS8 digit products and product origins as follows (Bernard et al 2007):

$$X_{pt} = F_{pt} \times N_{pt} \times \bar{X}_{fpt} \quad (1)$$

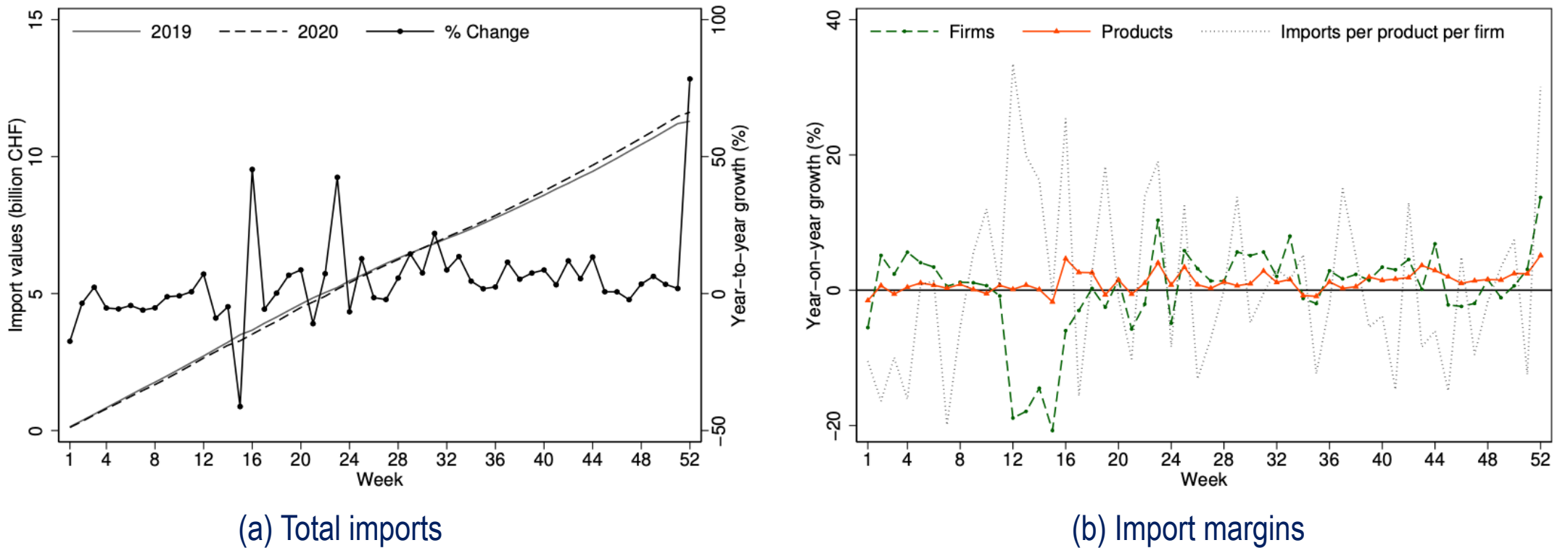
The diagram illustrates the decomposition of the equation $X_{pt} = F_{pt} \times N_{pt} \times \bar{X}_{fpt}$ into its components. Arrows point from each term in the equation to its corresponding label below:

- X_{pt} points to "Total product level imports"
- F_{pt} points to "Number of importing firms"
- N_{pt} points to "Number of imported products"
- \bar{X}_{fpt} points to "Average import value per product per firm"



Which margins adjusted and by how much?

Figure 3: Decomposing Swiss imports into different margins of trade





Conceptual framework and theoretical predictions

Grounded in recent trade theories with heterogeneous firms (Melitz, 2003; Chaney, 2008).

Domestic demand

- Reduced firm investment
- Reduced food demand
 - Food-away-from-home
- Lower domestic production
 - Increase imports
- In the end an empirical question

Increased trade costs

- Shipping costs
 - Reduce the imports of current importers
 - Increase the productivity level needed to import
- Lower worker productivity

Supply-side effects

- Production challenges
 - Yield losses
 - Seasonal labor shortages
- Export bans and NTMs
- Consequences depend on net-import position of importing country



Empirical analysis

$$\ln X_{pt} = \beta_0 + \beta_1 \ln \text{Covid19}_{t-5} + \beta_2 \text{Stringency index}_t + \beta_3 \ln(1 + \text{Tariff}_{pt}) + \theta_p + \lambda_w + \varepsilon_{pt}$$

- where X_{pt} is one of the trade margins defined earlier.
- B_1 is the number of COVID19 related deaths reported on day t in Switzerland
- B_2 is the policy environment on day t in Switzerland
- θ_p are product fixed effects and λ_w are week-year fixed effects
- We cluster the error terms at the product level
- We estimate equation (2) using OLS



Identifying assumptions

- The COVID19 case counts are exogenous shocks to firms
- We differentiate between the case counts and policy stringency index
- Our identification strategy therefore exploits variations in daily COVID-19 incident rates
as a predictor of daily product-level imports



Baseline results: Covid-19 and firm-level import adjustments

Table 2

OLS estimates of the effect of COVID19 on Swiss firm-level import margins.

	Total imports X_{pt}	Firms F_{pt}	Products P_{pt}	Imports/product/firm \bar{X}_{fpt}
	(1)	(2)	(3)	(4)
Log Covid _{<i>t-5</i>}	-0.276*** (0.039)	-0.174*** (0.015)	-0.031*** (0.006)	-0.071** (0.032)
Stringency index _{<i>t</i>}	0.011*** (0.002)	0.006*** (0.001)	0.001*** (0.000)	0.005*** (0.001)
Log Tariff _{<i>pt</i>}	-0.224*** (0.069)	0.035 (0.037)	0.130*** (0.018)	-0.389*** (0.031)
Product FE	Yes	Yes	Yes	Yes
Week-year FE	Yes	Yes	Yes	Yes
<i>N</i>	223680	223680	223680	223680
adj. <i>R</i> ²	0.521	0.566	0.754	0.521

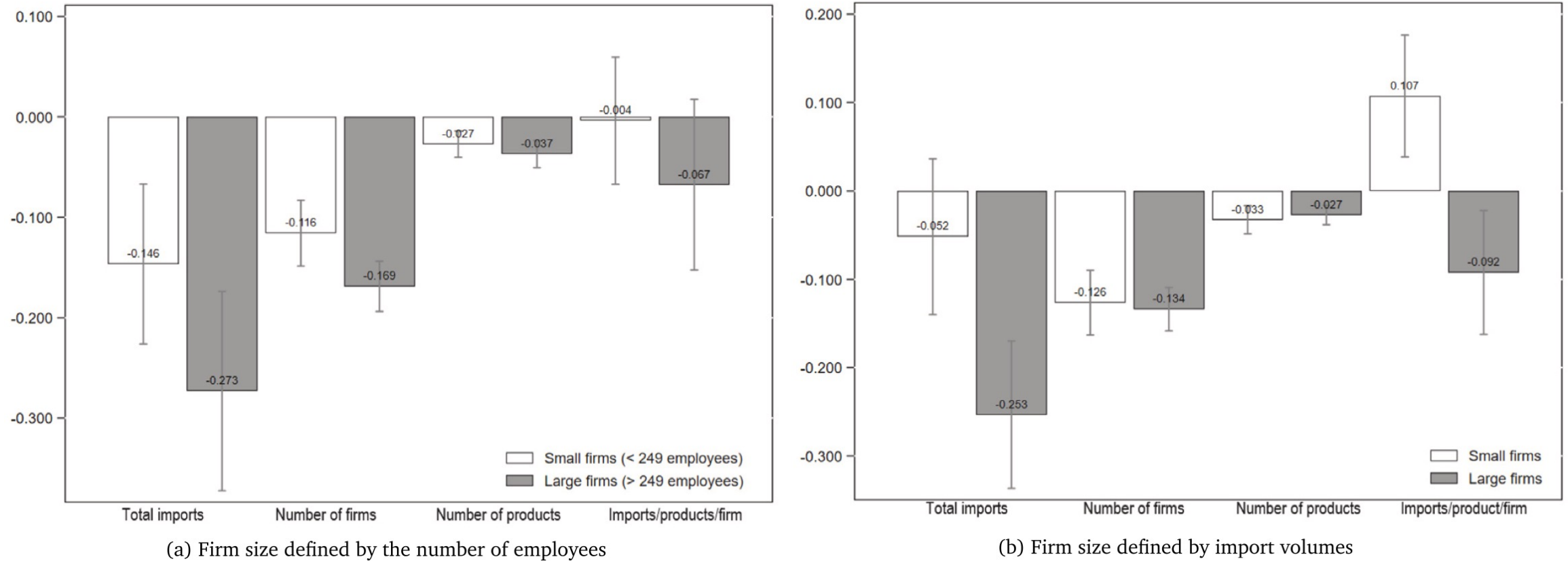
Notes: Data are in daily frequency. The dependent variable in column (1) is total Swiss imports – summed across all firms, HS8 digit products and origin countries – of product *p* on day *t*. F_{pt} is the number of active importing firms on day *t*, P_{pt} is the number of products imported on day *t* and \bar{X}_{fpt} is the import value per product per firm on day *t*. All models are estimated using ordinary least squares. *p* values are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported.

- The trade effects were driven mainly by a reduction in the number of importing firms (i.e., 63% of the total effect)
- Import loss due to a 10% increase in case count range from a mean of 1,898 CHF/day to a max of 208,813 CHF/day



Larger firms were affected more by the crisis

Fig. 3: Heterogeneity across firm sizes





Further heterogeneous effects

- Incumbent (multi-origin) firms were more affected than entrants (mono-origin) firms.
- All HS2 digit sectors had at least one trade margin affected by the pandemic.
 - Most had to adjust along multiple import margins
- The level of data analysis matters for the margins of trade adjustments.
 - At aggregate levels, the trade collapse is dominated by the intensive margin (Bricongne et al., 2022; Benguria, 2021).



Mechanisms: third country effects

$$\ln X_{fpot} = \beta_0 + \beta_1 \ln \text{Covid19}_{ot-1} + \beta_2 \text{Stringency index}_{ot-1} + \alpha_{fpm} + \alpha_{opm} + \varepsilon_{fpot}$$

	Import values in CHF		Import prices in CHF/kg		
	(1)	(2)	(3)	(4)	(5)
Log Covid _{t-1}	-0.014*** (0.005)	-0.035*** (0.013)	0.005*** (0.002)	0.005*** (0.002)	0.003* (0.002)
Stringency Index _{t-1}	0.000** (0.000)	0.002*** (0.001)	-0.000** (0.000)	-0.000 (0.000)	-0.000 (0.000)
High value product				0.763*** (0.007)	0.754*** (0.008)
Log Covid _{t-1} × High value product					0.005*** (0.001)
Firm-product-month FE	Yes	Yes	Yes	Yes	Yes
Origin-product-month FE	Yes	Yes	Yes	Yes	Yes
N	1111926	1111926	1049615	1049615	1049615
Estimator	OLS	PPML	OLS	OLS	OLS

Notes: Data are in weekly frequency. The dependent variable in columns (1) – (2) are the import values of firm *f* of HS8 digit product *p* from origin country *o* in week *t* of years 2019 and 2020. The dependent variable in columns (3) – (5) are the prices of imports — measured as CIF unit values — of firm *f* of HS8 digit product *p* from origin country *o* in week *t* of years 2019 and 2020. *p* values are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported.



Shocks in other countries reduced Swiss firm-level import volumes and increased import prices (more so for higher quality products)



Mechanisms: changes to consumer demand

Table 7: The effect on Covid-19 on consumer demand

	Consumer mobility		Consumer demand			
	Grocery (1)	Retail & Recreation (2)	Vegetables (3)	Fruits (4)	Meat (5)	Milk products (6)
Log Covid _{t-5}	-7.197*** (1.062)	-4.853*** (0.617)	-0.059*** (0.007)	0.067 (0.053)	-0.034*** (0.005)	-0.021*** (0.003)
Stringency index _t	0.215*** (0.021)	-0.585*** (0.028)	0.008*** (0.001)	0.005 (0.005)	0.008*** (0.001)	0.005*** (0.001)
Observation	5411	5411	1104	937	1356	782
adj. R ²	0.178	0.829	0.879	0.507	0.958	0.982

Notes: The data on consumer mobility are in daily frequency. Grocery is the daily change in visits to places like grocery markets, food warehouses, farmers markets, specialty food shops, drug stores, and pharmacies compared to a baseline day. Retail & Recreation is the daily change in visits to places like restaurants, cafes, shopping centers, theme parks, museums, libraries, and movie theaters compared to a baseline day. The baseline day is the median value from the 5-week period between January 3rd to February 6th 2020. The regression controls for the interaction between 2019 Canton level variables(population and GDP growth) and a linear time trend, canton and week fixed effects. The data on consumer demand is at the monthly level. *p* values are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported.



The pandemic reduced consumer demand



Concluding remarks and takeaways

- Understanding firm-level response to a global crisis is important to ensure food security during future shocks
- The pandemic reduced firm-level imports
- Driven more by drops in the number of importing firms
- The effects could also be explained by third-country supply-side effects but also changes to domestic consumer demand



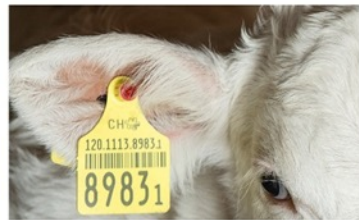
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Alternative Covid lag lengths

Table A9: OLS estimates of the effect of COVID19 on Swiss firm-level import margins: alternative lag lengths

Log Covid _t	-0.138*** (0.034)									
Log Covid _{t-1}		-0.402*** (0.045)								
Log Covid _{t-2}			-1.008*** (0.063)							
Log Covid _{t-3}				-0.024 (0.057)						
Log Covid _{t-4}					0.060 (0.051)					
Log Covid _{t-5}						-0.276*** (0.039)				
Log Covid _{t-6}							-0.169*** (0.035)			
Log Covid _{t-7}								-0.114*** (0.037)		
Log Covid _{t-8}									-0.369*** (0.043)	
Log Covid _{t-9}										-0.998*** (0.064)
Stringency index _t	0.007*** (0.001)	0.014*** (0.002)	0.018*** (0.002)	0.008*** (0.002)	0.009*** (0.002)	0.011*** (0.002)	0.007*** (0.001)	0.007*** (0.001)	0.013*** (0.001)	0.012*** (0.002)
Log Tariff _{pr}	-0.270*** (0.056)	-0.228*** (0.065)	-0.221*** (0.069)	-0.222*** (0.069)	-0.223*** (0.070)	-0.224*** (0.069)	-0.296*** (0.062)	-0.284*** (0.059)	-0.232*** (0.065)	-0.230*** (0.068)
Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Week-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	338038	255565	223615	220372	220083	223680	253968	294393	252572	221601
adj. R ²	0.542	0.527	0.516	0.518	0.518	0.521	0.590	0.571	0.526	0.516

Notes: Data are in daily frequency. The dependent variable is total Swiss imports — summed across all firms, HS8 digit products and origin countries — of product *p* on day *t*. All models are estimated using ordinary least squares. *p* values are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported.



Probability of firm exit

Table A7: COVID19 shock and the probability of firm exit

	Firm sizes based on employment		Firm sizes based on import volumes	
	Small Firms	Large Firms	Small Firms	Large Firms
	(1)	(2)	(3)	(4)
Log Covid _{t-1}	-0.006 (0.003)	0.012*** (0.002)	0.001 (0.003)	0.007** (0.003)
Stringency index _t	0.001*** (0.000)	-0.000** (0.000)	(0.003) (0.000)	(0.003) (0.000)
Log Tariff _{kt}	-0.004 (0.005)	0.012** (0.005)	-0.001 (0.005)	0.020** (0.008)
Observation	226992	210746	362716	88992
adj. R ²	0.079	0.076	0.065	0.084
Product FE	Yes	Yes	Yes	Yes
Month-year FE	Yes	Yes	Yes	Yes

Notes: Data are in weekly frequency. The dependent variable is a dummy variable that takes the value of one if a firm ceased to import a product in a given week. All models are estimated using ordinary least squares. *p* values are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported.



Multi- vs. Mono-origin firms

Table A8: COVID19 shocks in other countries and Swiss firm-level imports: multi- and mono-origin firms

	Import values in CHF	
	(1)	(2)
Log Covid _{t-1}	-0.035*** (0.013)	-0.030** (0.013)
Log Covid _{t-1} × Multi-origin firm		-0.053* (0.028)
Stringency index _t	0.002*** (0.001)	0.002*** (0.001)
Firm-product-month FE	Yes	Yes
Origin-product-month FE	Yes	Yes
<i>N</i>	1111926	1111926
Estimator	PPML	PPML

Notes: Data are in weekly frequency. The dependent variable is the import values of firm f of HS8 digit product p from origin country o in week t of years 2019 and 2020. p values are in parentheses. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported. We capture the multi-origin status of a firm by a dummy variable that identifies the top 10% importing firms in terms of number of origin markets, i.e., how many countries the firm import from.



Heterogeneity across quarters

Table A10: OLS estimates of the effect of COVID19 on import margins by quarter

	2020 Q1				2020 Q2				2020 Q3				2020 Q4			
	X_{pt} (1)	F_{pt} (2)	P_{pt} (3)	\bar{X}_{fpt} (4)	X_{pt} (5)	F_{pt} (6)	P_{pt} (7)	\bar{X}_{fpt} (8)	X_{pt} (9)	F_{pt} (10)	P_{pt} (11)	\bar{X}_{fpt} (12)	X_{pt} (13)	F_{pt} (14)	P_{pt} (15)	\bar{X}_{fpt} (16)
Log Covid $_{t-5}$	-0.274*** (0.040)	-0.155*** (0.013)	-0.020*** (0.006)	-0.098*** (0.034)	-0.524*** (0.098)	-0.293*** (0.036)	-0.083*** (0.015)	-0.148* (0.081)	-3.218 (7.163)	-3.795 (2.461)	-0.574 (1.023)	1.151 (5.946)	-1.593*** (0.269)	-1.015*** (0.098)	-0.223*** (0.039)	-0.355 (0.222)
Stringency index $_t$	0.016*** (0.002)	0.007*** (0.001)	0.001*** (0.000)	0.008*** (0.002)	-0.025*** (0.005)	-0.009*** (0.002)	-0.002*** (0.001)	-0.014*** (0.004)	-0.133*** (0.013)	-0.096*** (0.005)	-0.020*** (0.002)	-0.017 (0.011)	0.030*** (0.003)	0.015*** (0.001)	0.003*** (0.000)	0.012*** (0.002)
Log Tariff $_{kt}$	0.066 (0.081)	0.241*** (0.041)	0.193*** (0.019)	-0.369*** (0.052)	0.010 (0.082)	0.158*** (0.042)	0.192*** (0.019)	-0.341*** (0.050)	-0.042 (0.071)	0.162*** (0.037)	0.161*** (0.022)	-0.365*** (0.041)	-0.113 (0.092)	0.130*** (0.045)	0.154*** (0.023)	-0.397*** (0.048)
Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Week-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	27393	27393	27393	27393	26268	26268	26268	26268	28506	28506	28506	28506	29351	29351	29351	29351
adj. R ²	0.558	0.620	0.788	0.535	0.536	0.560	0.767	0.543	0.557	0.597	0.761	0.553	0.530	0.587	0.775	0.528

Notes: Data are in daily frequency. All models are estimated using ordinary least squares. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported. X_{pt} is total Swiss imports — summed across all firms, HS8 digit products and origin countries — of product p on day t . F_{pt} is the number of active importing firms on day t , P_{pt} is the number of products imported on day t and \bar{X}_{fpt} is the import value per product per firm on day t .



Sector-specific effects

- All sectors had at least one trade margin affected by the pandemic
- Most had to adjust along multiple import margins

Table 3: HS2 sector specific effects

HS group	X_{pt}	F_{pt}	P_{pt}	\bar{X}_{fpt}	N
HS01: Animals, live	0.661	0.429**	-0.055	0.287	1139
HS02: Meat	-0.066	-0.215***	-0.011	0.161	10763
HS03: Fish and crustaceans	0.049	-0.026	-0.003	0.078	26596
HS04: Dairy produce	0.321	-0.034	-0.114***	0.469**	7858
HS05: Animal products, nes	0.222	-0.179	-0.034	0.435**	2193
HS06: Trees and other plants	-0.630***	-0.508***	-0.038	-0.084	8492
HS07: Vegetables	-0.489***	-0.403***	-0.120***	0.034	26580
HS08: Fruits and nuts	-0.580***	-0.357***	-0.013	-0.210**	26240
HS09: Coffee, tea, mate, spices	-0.308*	-0.077	-0.003	-0.228*	11688
HS10: Cereals	-0.253	0.041	0.038	-0.331	3702
HS11: Products of the milling industry	-0.123	-0.079	-0.026	-0.017	7698
HS12: Oil seeds	-0.332	-0.191***	-0.047**	-0.095	9321
HS13: Lac; natural gums, resins	-0.127	-0.090	0.044	-0.081	2116
HS14: Vegetable plaiting materials	0.165	-0.014	0.006	0.173	1299
HS15: Animal, vegetable fats and oils	-0.485***	-0.074*	-0.030	-0.382**	9527
HS16: Meat, fish; preparations	-0.315***	-0.132***	-0.006	-0.177	11619
HS17: Sugars and sugar confectionery	-0.800***	-0.173*	-0.110*	-0.518*	5044
HS18: Cocoa and cocoa preparations	0.369**	-0.004	0.025	0.348**	3467
HS19: Preparations of cereals	0.005	-0.127**	-0.061**	0.193	7367
HS20: Preparations of vegetables, fruits	-0.196	-0.049	0.034	-0.182	16548
HS21: Miscellaneous edible preparations	-0.492	-0.204*	-0.048	-0.239	7540
HS22: Beverages, spirits, vinegar	-0.463***	-0.268***	0.025	-0.220*	9941
HS23: Residues of food industry	-0.392***	-0.211***	-0.068	-0.114	4429
HS24: Tobacco	-0.027	0.038	-0.019**	-0.046	2513

Notes: Data are in daily frequency. All models are estimated using ordinary least squares. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported. X_{pt} is total imports. F_{pt} is the number of active importing firms, P_{pt} is the number of imported products and \bar{X}_{fpt} is the import value per product per firm.



Incumbent firms were affected & entrant firms not much

	Incumbents				Entrants			
	X_{pt} (1)	F_{pt} (2)	P_{pt} (3)	\bar{X}_{fpt} (4)	X_{pt} (5)	F_{pt} (6)	P_{pt} (7)	\bar{X}_{fpt} (8)
Log Covid _{t-5}	-0.296*** (0.042)	-0.186*** (0.016)	-0.035*** (0.007)	-0.075** (0.035)	-0.102 (0.135)	-0.002 (0.029)	-0.032* (0.017)	-0.068 (0.129)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Week-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	199486	199486	199486	199486	11225	11225	11225	11225
adj. <i>R</i> ²	0.524	0.563	0.747	0.529	0.322	0.395	0.468	0.330

Notes: Data are in daily frequency. All models are estimated using ordinary least squares. ***, ** and * denote significance at 1%, 5% and 10% respectively. Intercepts included but not reported. X_{pt} is total imports. F_{pt} is the number of active importing firms, P_{pt} is the number of imported products and \bar{X}_{fpt} is the import value per product per firm.

The level of data analysis matters for the findings

	Weekly data				Monthly data			
	X_{kt} (1)	F_{kt} (2)	P_{kt} (3)	\bar{X}_{fkt} (4)	X_{kt} (5)	F_{kt} (6)	P_{kt} (7)	\bar{X}_{fkt} (8)
Log Covid _{<i>t</i>-1}	-0.030*** (0.007)	-0.011*** (0.002)	0.000 (0.001)	-0.020*** (0.006)	-0.009** (0.004)	0.003* (0.001)	0.001 (0.001)	-0.012*** (0.003)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month-year FE	Yes	Yes	Yes	Yes	No	No	No	No
Year FE	No	No	No	No	Yes	Yes	Yes	Yes
<i>N</i>	70808	70808	70808	70808	16872	16872	16872	16872
adj. <i>R</i> ²	0.841	0.932	0.931	0.778	0.906	0.959	0.953	0.859

At aggregate levels, the trade collapse is dominated by the intensive margin. Supports evidence from existing studies (Bricongne et al., 2022; Benguria, 2021).